DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS

SPK-15506 (June 1990)

GUIDE SPECIFICATION FOR MILITARY CONSTRUCTION

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SECTION 15506

AFFF FOAM FIRE PROTECTION, DETECTION AND ALARM SYSTEM
06/90

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NOTE: This guide specification covers aircraft hangars, shelters, maintenance docks, and similar facilities. Using this specification for other types of projects, or facilities with office space, may require editing beyond the scope of these notes. For guidance in editing this guide specification, designers shall refer to the most currently dated ETL 1110-3-411. This guide specification is to be used in the preparation of project specifications in accordance with ER 1110-345-720.

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PART 1 GENERAL

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NOTE: See Additional Note A.

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1.1 SUMMARY (Not Applicable)

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NOTE: Paragraph "1.1 SUMMARY (Not Applicable)" is required in all CEGS in order to make CEGS compatible with guide specifications of other and agencies within the SPECSINTACT system. However, this paragraph is not to be included in Corps of Engineers project specifications.

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1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AFFF FOAM FIRE PROTECTION, DETECTION AND ALARM SYSTEM SPK-15506 (June 1990)

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI) STANDARDS:

B16.1-1975	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
B16.4-1985	Cast Iron Threaded Fittings, Class 125 and 250.
B16.18-1984	Cast Bronze Solder Joint Pressure Fittings.
B16.21-1978	Non Metallic Flat Gaskets for Pipe Flanges
B16.22-1980	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
B18.2.1-1981	Square and Hex Bolts and Screws Inch Series.
B18.2.2-1972 (R 1983)	Square and Hex Nuts.
B40.1-1985	Gauges-Pressure, Indicating Dial Type Elastic Element
B112.1-1970	Hose Valves for Fire Protection.
C62.42-1980	Guide for Surge voltage in Low-Voltage AC Power Circuits

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:

A 53-87b	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
A 135-86	Electric-Resistance-Welded Steel Pipe.

A 307-87	Carbon Steel Externally and Internally Threaded Standard Fasteners.
A 325-86a	High-Strength Bolts for Structural Steel Joints.
A 575-86a	Steel Bars, Carbon, Merchant Quality, M-Grade.
A 576-87	Steel Bars, Carbon, Hot-Rolled, Special Quality.
B 32-87	Solder Metal.
B 75-86	Seamless Copper Tube.
B 88-88	Seamless Copper Water Tube.
B 251-88	Wrought Seamless Copper and Copper-Alloy Tube.

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NOTE: If there is no underground AFFF concentrate piping in the project, delete the following 4 references to PVC pipe.

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D 2464-76	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
D 1785-86	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules, 40, 80 and 120.
D 2467-87	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
D 2564-84	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe, and Fittings.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE) PUBLICATIONS:

No. 1012	Backflow Preventers with Intermediate Atmospheric Vent (May 1972)

AMERICAN WATER WORKS ASSOCIATION (AWWA) STANDARDS:

B300-87	Hypochlorites.
B300-81	Liquid chloride.
C104-85	Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water
C110-82	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
C111-85	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
C115-88	Flanged Ductile-Iron and Gray-Iron Pipe With Threaded Flanges
C151-86	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or Other Liquids.
C200-86	Steel Water Pipe 6 In. and Larger
C203-86	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied.
C207-86	Steel Pipe Flanges for Waterworks Services -Sizes 4 In. through 144 In. Small
C500-80 & Correction	Gate Valves, 3 through 48 Inc. NPS, for Water and Sewage Systems

AMERICAN WELDING SOCIETY (AWS) PUBLICATION:

A5.8-81	Specification for Brazing Filler Metal

FACTORY MUTUAL SYSTEM (FM) PUBLICATION:

Approved Guide (Equipment, Materials, Services for Conservation of Property) 1987, with Quarterly Supplements.

FEDERAL SPECIFICATIONS (FED. SPEC.)

HH-G-156D & Int Am-1	Gasket Material, General Purpose; Rubber Sheets, Strips, and Special Shapes.

QQ-C-40 & Am -2	Calking: Lead Wool and Lead Pig.
WW-P-421D	Pipe, Cast Gray and Ductile Iron, Pressure (For Water and Other Liquids).
WW-P-521G	Pipe Fittings, Flange Fittings, and Flanges: Steel and Malleable Iron (Threaded and Butt-Welding) Class 150.
WW-V-1967 & Am-1	Valve, Butterfly (Threaded Ends, Solder ends) Brass or Bronze

FEDERAL STANDARD (FED. STD.):

H28 & Suppl 1A	Screw-Thread Standards for Federal Services.
No. 595A & Change Notices 2, 3, 4, 5, 7 & Errata, 8, 9	Colors

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS) STANDARDS:

SP-69	Pipe Hangers and Supports - Selection and Application (1983).
SP-70	Cast Iron Gate Valves, Flanged and Threaded Ends (1976).
SP-80	Bronze Gate, Glove, Angle and Check Valves (1979).

MILITARY SPECIFICATIONS (MIL SPECS)

MIL-F-24385C	Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate for Fresh and Sea Water

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS:

11-1988	Low Expansion Foam and Combined Agent Systems.
13-1989	Installation of Sprinkler Systems.
14-1986	Standpipe and Hose Systems.
15-1985	Water Spray Fixed Systems for Fire Protection.
16-1986	Deluge Foam-Water Sprinkler and Foam-Water Spray Systems.
16A-1988	Installation of Closed-Head Foam-Water Sprinkler Systems.
24-1987	Installation of Private Fire Service Mains and Their Appurtenances
70-1987 & Errata & Int Am 70-87-2	National Electrical Code
72A-1987	Local Protective Signaling System.
72D-1986	Proprietary Protective Signaling Systems.
72E-1987	Automatic Fire Detectors.
72H-1984	Testing Procedure for Local, Auxiliary, Remote Station and Proprietary Protective Signaling
409-1985	Aircraft Hangars.

Where the NFPA standards cited above conflict with the remainder of this specification, this specification shall govern.

UNDERWRITERS' LABORATORIES, INC. (UL) PUBLICATION:

Fire Protection Equipment Directory (Jan 1987 with Quarterly Supplements)

UL 6	Rigid Metal Conduit (Oct 23, 1981, 9th Ed.; Rev Oct 10, 1983; Errata)

UL 38	Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems (Jul 23, 1981, 4th Ed.; Rev thru Dec 19, 1985)
UL 464	Audible Signal Appliances (Dec 1, 1981, 5th Ed.; Errata; Rev thru Dec 20, 1985)
UL 467	Grounding and Bonding Equipment (Nov 22, 1984, 6th Ed.; Rev thru Apr 30, 1985)
UL 521	Heat Detectors for Fire Protective Signaling Systems (Sep 29, 1978, 4th Ed.; Rev thru Sep 16, 1986)
UL 864	Control Units for Fire Protective Signaling Systems (Jun 6, 1980, 6th Ed., Rev thru May 26, 1987)

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of manufacturers regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat sensitive plate which is securely attached to the equipment.

1.3.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.4 Compliance

The fire detection and internal alarm system shall be configured in accordance with NFPA 72A and 72D. The central reporting systems shall be configured in accordance with NFPA 72D. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.5 Manufacturer's Services

A manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.3.6 Welding

Welding shall be in accordance with NFPA 13. Only shop welding with appropriate welding fittings shall be used.

1.4 SUBMITTALS

SD-20 Connection Diagrams

Wiring diagrams shall show all alarm initiating and evacuation signaling devices, and identify all terminations, including terminal identifications even if unused, and shall include a schedule of connections consistent with that on the diagrams. Wiring diagrams shall identify the devices by manufacturer and model number.

Detailed wiring diagrams shall be provided for all control panels, control panel modules, power supplies, electrical power connections, auxiliary function relays and annunciation equipment, and shall include a written schedule of connections consistent with that on the diagrams. Detailed wiring diagrams shall identify the devices shown by manufacturer and model number.

SD-31, Detail Drawings

The Contractor shall submit [6] [_____] full sets of detail drawings in accordance with the SPECIAL CLAUSES which shall include a complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Detail drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings

shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. Working drawings and calculations shall be signed and stamped by a registered fire protection engineer who is regularly engaged in fire protection and detection design of these systems or a registered professional engineer who has had at least 2 years experience in design of fire protection systems as well as previous experience in the design of fire protection systems for aircraft hangars having similar type AFFF fire protection systems as required by this project. Qualifications with verification or license number of the registered engineer shall be submitted to and approved by the Contracting Officer. The fire detection and alarm system shall be coordinated with the fire protection system. The Contractor shall not begin any of the work shown in these drawings prior to receiving written approval from the Contracting Officer.

Each set of detail drawings shall include the following:

a. A legend sheet identifying all device symbols, nomenclature and conventions used in the shop drawing package.

b. A drawing list identifying all drawings in the shop drawing package by Title, Drawing Number and Specification cross-reference.

c. Floor plan drawings showing locations of all devices, equipment, risers, and electrical power connections, and ultra violet infrared flame detector viewing areas.

d. Number of conduits, conduit routing, and size.

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NOTE: If the diaphragm tank option is chosen, delete inappropriate paragraphs. See paragraphs below, and the note following the Products section.

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Detail drawing submittals shall include electrical detail drawings for the AFFF concentrate pumps, [and connection to the [existing] fire pumps] including electrical current characteristics; wire type, sizing, routing and connection points to building electrical system; and type and rating of all equipment and components.

Hydraulic calculations for the pre-action foam/water sprinkler system meeting all the requirements of NFPA 13 and NFPA 16A shall be submitted.

Detail drawings for the hydraulically designed pre-action foam/water sprinkler systems shall show all of the information required by NFPA 13 for working plans and shall include drawings showing construction and location of all equipment, controls, piping, valves, drains, sway bracing, flexible couplings installed as flexure joints, location and diameter of all pipe penetrations, pipe sleeves and pipe clearance openings in walls and floors. The detail drawings shall show detailed pipe supporting and restraining methods proposed for the risers, cross mains, feed mains, branch lines, proportioning equipment, drains, and test connections.

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NOTE: If the diaphragm tank option is chosen, delete bracketed words (See paragraphs below).

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The foam proportioning piping arrangement, including concentrate tank, tank connections and trim, [pumps, flow regulating valves, in line balanced pressure proportioners], relief valves, ratio controllers and concentrate lines shall be clearly identified.

The valve trim arrangement for the deluge valves and the AFFF concentrate valves shall be drawn in sufficient detail to determine the valve opening and closing arrangements.

The detail drawings shall show detailed mounting, location, supports, and damage protection for all monitor nozzles, monitor nozzle feed piping, and overhead system risers.

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NOTE: If the diaphragm tank option is chosen, delete inappropriate paragraphs. (See paragraphs below.)

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The detail drawings for the packaged (skid mounted) AFFF pumping system shall be approved by the manufacturer of the in line balanced pressure proportioning equipment prior to submission to the Contracting Officer for approval. The Contractor shall submit proof of such approval.

These diagrams shall depict and identify all circuit boards, modules, power supplies, dip switches, jumpers, indicating lights, LEDs adjustable controls or components, ribbon connectors, wiring harnesses, batteries, terminal strips and connections thereto, including spare zones or circuits.

Diagrams required by this section shall depict the required information to

relative scale, actual size or larger, showing proper spatial relationships between components.

Power supply/stand-by battery load calculations shall be submitted for each power supply and each initiating, indicating and releasing circuit in the system.

The floor plan drawing, wiring diagram, and detailed wiring diagram shall be cross-referenced to all related drawings. The complete submittal shall include all information necessary for installation of the complete system.

The Contractor shall show, to the satisfaction of the Contracting Officer, that the control equipment, control equipment modules, detectors signaling devices, releasing devices, foam release stations, and abort stations are electrically compatible and either are the standard product of a single manufacturer, or cross-listed for use with one another. Any components determined by the Contracting Officer or by system testing or by operational experience to be either noncompatible or non-listed for use with one another shall be replaced with equipment or components which are compatible at no additional cost to the Government.

Only complete submittals containing all required information will be reviewed. Incomplete submittals will be returned to the Contractor without being reviewed.

SD-64, Quality Assurance Plan

The Contractor shall submit test procedures to the Contracting Officer for approval. Test procedures shall describe all tests to be performed, including a step by step procedure, list of equipment to be used, and a list of personnel who will perform the tests. The test plan for all tests required by this specification shall be approved by the Contracting Officer prior to scheduling any tests.

Prior to scheduling system testing, the Contractor shall submit an AFFF waste containment and disposal plan to the Contracting Officer for approval. Only after it's approval shall the Contractor schedule system testing.

SD-70, Test Reports

Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

SD-72, Training Data

Within 3 working days after the conclusion of the initial operator and follow-on training sessions specified hereinafter, the Contractor shall deliver the videotapes of these sessions to the Contracting Officer.

SD-76, Certificates of Compliance

The Contractor shall upon completion of construction provide an installation certificate. The certificate shall be issued by a service company listed in the UL Fire Protection Equipment Directory under Protection Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUUS).

SD-80, Operating and Maintenance Manuals

Operating and maintenance instruction manuals shall be furnished in accordance with the SPECIAL CLAUSES.

SD-81, Operating Instructions

The Contractor shall furnish the Contracting Officer 3 complete copies of operating instructions outlining step-by-step procedures required for system start up, operation, and shut down. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Operating instructions shall be submitted and approved prior to training course.

SD-82, Preventive Maintenance and Inspection

The Contractor shall furnish the Contracting Officer 3 copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams for the system as installed. Maintenance instructions shall be submitted and approved prior to training course.

SD-90, As-Built Drawings

The Contractor shall maintain on-site a separate set of approved detail drawings for the overall system, marked up to indicate as-built conditions. These drawings shall be maintained in a current condition at all times and shall be made available for review immediately upon request during normal working hours. All variations from the approved detail drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials and/or required coordination between trades shall be

indicated in sufficient detail to accurately reflect the as-built conditions. The as-built drawings shall include all information required for the detail drawings as specified above. The as-built drawings shall be reproducible, and shall be submitted to the Contracting Officer with 6 sets of blueline copies within 14 calendar days after successful completion of all required testing.

The requirements for as-built drawings in this Section are in addition to the requirements of the SPECIAL CLAUSES. In addition to any other sums retained or withheld pursuant to the provisions of this contract, the amount of [$10,000] [_____] will be withheld by the Government from the payments to the Contractor until such time as the as-built drawings specified in this section have been submitted to and approved by the Contracting Officer. In no event will this amount be paid to the Contractor prior to 30 days following submission of these as-built drawings.

Upon Approval of the as-built drawing submittal and before acceptance of the project, the Contractor shall provide plasticized half-scale copies of all detailed wiring diagrams required for the shop drawing submittal, updated to reflect as-built conditions. One plasticized, half-scale copy shall be [attached to the inside of the door of the fire alarm control panel closet] [_____] [where indicated], mounted under framed clear plastic and one copy shall be included in each Operating and Maintenance Manual as specified hereinafter.

SD-92, Spare Parts Data

After approval of the detail drawings, the Contractor shall furnish, in accordance with the SPECIAL CLAUSES, copies of spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust and any other contaminants.

1.6 DETECTION AND ALARM SYSTEM DESIGN

System shall be a complete, supervised, zoned fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until initiating device

is reset and the fire alarm control panel is manually reset and restored to normal. All circuits shall be capable of operating under a single ground or open condition, except primary and emergency power supplies. The sequence of control shall be as indicated on the drawings.

The system shall have the following operating features:

a. Electrical supervision of alarm initiating circuits (fire detectors, foam release and abort stations) shall be style Z per NFPA 72A. Electrical supervision of alarm indicating circuits (signaling devices and alarm transmission) shall be style Z per NFPA 72A.

b. Electrical supervision of circuits used to activate fire extinguishing systems: [including deluge valves,] [fire pumps,] [AFFF pumps,] [and ____]. Supervision shall include the coil of the releasing solenoid. Circuits shall be 4 wire circuits which operate despite a device ground fault, wire to wire short, or an open circuit in a single conductor.

c. Electrical supervision of the primary power (ac) supply, presence of the battery, battery voltage, placement of alarm zone modules within the control panel, and transmitter tripping circuit integrity.

d. Trouble buzzer and trouble indicator lamp (light emitting diode or neon light) to activate upon a single break, open circuit, or ground fault condition which prevents the required normal operation of the system; trouble signal for battery supply, low battery voltage, removal of alarm zone modules, and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silencing switch shall be provided that will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

e. Transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter.

f. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will affect neither the zone indicating lamp nor the operation of the transmitter. This switch shall be overridden upon activation of a subsequent alarm from an unalarmed zone.

g. Switch which will bypass the automatic fire suppression system

operation. Operation of the switch shall activate the system trouble signal. Access to this switch shall require the use of a key.

h. Electrical Supervision of circuits used for supervisory signal services (i.e. supervised valves) shall be style D per NFPA 72A.

i. Zones for alarm initiating circuits shall be arranged as indicated on the contract drawings.

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NOTE: Alarm zoning and fire suppression response sequence shall be indicated on the drawings.

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1.6.1 Operating Power

Operating power shall be single phase taken from the building electric service as specified. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

Emergency power shall be provided by rechargeable sealed-type storage batteries and battery charger.

1.7 OVERVOLTAGE AND SURGE PROTECTION:

All equipment connected to alternating current circuits shall be protected from power line surges. Equipment shall meet requirements of ANSI C62.41. Fuses shall not be used for surge protection.

All communications equipment shall be protected against surges induced on any communications link. All cables and conductors, except fiber optics, which serve as communications links shall have surge protection circuits installed at each end that meet the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Protection shall be provided at the equipment. Additional triple electrode gas surge

protectors, rated for the application, shall be installed on each wireline circuit within three feet of the building cable entrance. Fuses shall not be used for surge protection.

All digital and analog inputs and outputs shall be protected against surges induced by sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested with the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Fuses shall not be used for surge protection.

1.7.1 Power Filter

A power filter shall be provided for the fire alarm control panel. The power filter shall filter power to meet the needs of the UV/IR flame detectors per the flame detector manufacturers recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment shall conform to the respective publications and other requirements specified herein.

2.1.1 Keys and Locks

Locks shall be keyed alike. Tags with stamped identification number shall be furnished for keys and locks.

2.1.2 Bolts and Nuts

Squarehead Bolts and Heavy Hexagon Nuts ANSI B18.2.1 and B18.2.2 and ASTM A 307, A 575, or A 576. Underground Bolts: ASTM A 325.

2.1.3 Brazing Filler Metal: AWS A5.8, Classification BCuP-3 or BCup-4.

2.1.4 Calking Lead: Fed. Spec. QQ-C-40, Type I.

2.1.5 Flange Dimensions: ANSI B16.1 or AWWA C207.

2.1.6 Gauges: ANSI B40.1.

2.1.7 Gaskets:

Flange Gaskets: ANSI B16.21. Underground gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for cast-iron and ductile-iron pipe joints shall conform to AWWA C111.

2.1.8 Hypochlorites: AWWA B300.

2.1.9 Lubricants

Gasket lubricant shall be as recommended by the pipe manufacturer.

Thread-cutting oil shall be an all-purpose lubricant free from animal or vegetable compounds.

2.1.10 Pipe For Underground Installation:

2.1.10.1 Cast-Iron Pipe

Fed. Spec. WW-P-421, Type II or Type III, working pressure not less than 175 psi, AWWA C151 with cement-mortar lining conforming to AWWA C104.

2.1.10.2 Ductile Iron Pipe

AWWA C115, working pressure not less than 175 p.s.i. unless otherwise shown or specified. Pipe shall be cement-mortar-lined.

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NOTE: If there is no underground AFFF concentrate piping in the project, delete all paragraphs refering to PVC piping.

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[2.1.10.3 Poly (Vinyl Chloride) (PVC) Plastic Pipe

All pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B. PVC pipe shall be used only for underground AFFF concentrate piping, and shall not be used for other piping. All PVC pipe and fittings shall be Schedule 80.

2.1.10.4 PVC Pipe Connections

All PVC pipe to PVC pipe connections shall be solvent cement joint conforming to the dimensional requirements of ASTM D 1785 with joints

meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Solvent cement joints shall utilize sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specified recommendations.

2.1.11 Joints

Joints connecting PVC pipe to pipe of different materials shall be in accordance with the manufacturer's written recommendation, and as approved by the Contracting Officer.]

2.1.12 Pipe Fittings

Cast gray, iron or cast ductile iron pipe fittings shall conform to AWWA C110 or ANSI B16.1.

2.1.13 Aboveground Installation

2.1.13.1 Copper Tubing

ASTM B 75 or ASTM B 88, of copper Nos. 102, 103, and 108. ASTM B 75 tube meeting the requirements of ASTM B 251 will be acceptable only in drawn or hard drawn and must meet the mechanical property requirements of Table 2 in ASTM B 88, the roundness tolerance of Table 3, the dimensional requirements of Table 4, with wall thickness to Type K, L, or M equivalent, and length to Table 5. Tube conforming to ASTM B 88 shall be type K, L, or M.

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NOTE: It is recommendation of Factory Mutual personnel that preaction and/or deluge piping be galvanized to prevent scaling of the inside of the pipe over an extended period of time. Bracketed words should be deleted only after consultation with the Project Manager.

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2.1.13.2 Pipe

ASTM A 53, Schedule 40, AWWA C200. Electric-resistance welded steel pipe shall conform to ASTM A 135 and wall thickness shall comply with NFPA 13. [Pipe shall be galvanized in accordance with ASTM A-53, or coated and lined in accordance with AWWA C 203. Fittings are not required to be galvanized.] Threading of Schedule 10 pipe shall not be permitted.

All aboveground AFFF concentrate piping shall be Schedule 40 stainless steel of the 300 series.

2.1.13.3 Fittings

For aboveground installation, fittings may be cast iron or malleable iron for steel pipe and brazed or soldered cast or wrought bronze or wrought copper for copper pipe.

Cast iron fittings shall conform to AWWA C110 or ANSI B16.1 and ANSI B16.4, [or shall be grooved coupling types, UL listed or FM approved for dry pipe and/or preaction fire sprinkler service. Plain end piping and fittings shall not be acceptable].

Malleable-iron fittings shall conform to Fed. Spec. WW-P-521, type to match adjacent piping.

Cast copper alloy pressure fittings shall conform to ANSI B16.1 and wrought copper and bronze pressure fittings shall conform to ANSI B16.22.

2.1.14 Pipe Hangers

Hangers shall be in accordance with NFPA 13, and in accordance with UL requirements for use in sprinkler systems. When used, MSS SP-69 type 19 and Type 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices furnished by the manufacturer. The C-clamp body shall not be constructed from bent plates.

2.1.15 Solder Metal

ASTM B 32, 95-5 (tin-antimony-alloy grade Sb5).

2.1.16 Valves

Seat material for valves in AFFF concentrate piping shall be compatible with AFFF concentrate. Buna-N (nitrile) type valve seats shall be acceptable only for valves conveying water or foam-water solution.

Gate valves under 2-inch size valves shall be in accordance with MSS SP-80; 2-inch to 3-inch size valves shall conform to the requirements of MSS SP-80 or MSS SP-70, Class 150; above 3-inch size gate valves shall meet the requirements of MSS SP-70 Class 150; or AWWA C500. Outside screw and yoke gate valves shall conform to UL-04 requirements.

Check valves under 3-inch size valves shall meet the requirements of MSS

SP-80 class 150. Valves 3-Inch and larger shall be iron body, bronze-mounted. All valves shall be listed in UL Fire Protection Equipment Directory or FM Approval Guide and shall be straightway type, suitable for vertical or horizontal installation with end connections as required to mate with piping in which the valve must be installed.

Hose valves shall be all brass or bronze, gate valve type straightway pattern, UL listed or FM approved.

Butterfly valves shall be per Fed. Spec. WW-V-1967 UL listed with wafer body designed for installation between ANSI B16.1, Class 150 flanges. For valves larger than 6-inch nominal size, manufacturer's certified drawings showing construction, dimensions, and material used for all valve parts and operator shall be required. Butterfly valves shall have a visual position indicator distinguishing open and closed positions, and shall be supervised as indicated.

2.1.17 Switches

Switches for valve supervision shall be tamperproof housed in cast aluminum enclosure. All switches installed outside of building shall have weatherproof enclosure. Contacts shall be single pole, double throw. Brackets or supports shall be provided for attachment to valve. Switches shall close when the supervised valve is shut off. Switches shall be UL listed or FM approved.

2.1.18 Strainer

175 psi flanged basket type of cast steel or iron body with stainless steel basket, ANSI B 16.5. Cover shall be gasketed, clamp type for quick removal. Basket surface area shall be at least 3 times the inlet pipe area, with screen holes of approximately 1/4 inch diameter.

2.1.19 AFFF Foam Concentrate

AFFF Foam Concentrate shall conform to Military Specifications MIL-F-24385C, type 3, for a 3% AFFF and water solution. All AFFF concentrate shall be the product of one manufacturer; mixing of non-identical AFFF brands or products shall not be permitted. The original AFFF containers shall remain on the jobsite until a representative of the Contracting Officer has verified the type and quantity of AFFF provided.

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NOTE: This specification has been written for either proportioning by pumping AFFF from an

atmospheric pressure storage tank or by a diaphragm tank system. The following factors shall be considered prior to making a choice:

a. Some using services and major commands have a preference for pumped systems, or for diaphragm tank systems. The A/E shall comply with this preference if so instructed by the Corps of Engineers project manager.

b. Diaphragm tanks are suited to smaller systems (less than 1500 gallons of AFFF concentrate), and are simpler and less costly. The tanks are difficult to fill and maintain, and can be prone to leakage and cross contamination. Diaphragm tanks need to be located close to the protected area. Under no circumstances shall remote diaphragm tank systems be employed. If multiple ratio controllers are to be used with a single tank, they must be arranged in a symmetrical manner: that is with all ratio controllers being of the same size, and all connected to the tank with equal lengths and sizes of pipe. For an asymmetric arrangement, a pumped balanced pressure proportioning system is required.

c. If a pumped AFFF system is chosen the Architectural-Engineer project design effort shall include providing emergency back-up power for the electric pumps if the building is not provided with basewide back-up power. The Architectural-Engineer shall coordinate this requirement with the Corps of Engineers Project Manager.

****

2.2 ATMOSPHERIC AFFF TANK WITH PUMPS

****

NOTE: Atmospheric AFFF tank with pump option begins here.

****

AFFF Concentrate Proportioning Means shall be a balanced pressure

proportioning system meeting the requirements of NFPA 16A and shall be of the type as described below:

a. AFFF storage tank shall be constructed of plastic (high density cross-linked polyethylene) or fiberglass material specifically approved for storage of AFFF concentrate by the AFFF manufacturer. Tank supports shall be integral with tank design. Supports shall resist seismic overturning and supports bracing and anchors shall comply with SECTION: SEISMIC PROTECTION MECHANICAL, ELECTRICAL EQUIPMENT. Seismic calculations shall be submitted to the Contracting Officer. The tank shall be equipped with supply, return, drain, and fill openings. The tank shall have an expansion dome and access cleanout meeting the requirements of NFPA 16, and a sight gauge or other liquid level measuring device. The tank capacity shall not be less than indicated on the drawings. The contractor shall provide the tank with 3% type AFFF (aqueous film forming foam) concentrate. Upon successful completion of all required tests entailing the discharge of foam, the Contractor shall refill the tank (and all foam concentrate piping) to its full capacity.

********** **********

NOTE: Drawings must show in detail all piping and valving arrangements of all foam proportioning components.

****

b. Packaged AFFF pumping system shall be a skid mounted unit complete with all valves, controls, wiring, pumps, etc. to pump AFFF concentrate from the atmospheric pressure storage tank to a pipeline supplying the in-line balanced pressure proportioning units with AFFF concentrate at the required flow rates and pressures. Excess AFFF pump output not required by pipeline demand shall be returned to the tank by a modulating flow regulating valve. All piping and fittings shall be Schedule 40, 300 series stainless steel, with 150 lb. flanges for tank and supply pipeline connections. The packaged pumping system shall conform to the schematic diagram on the drawings and shall include:

Duplex AFFF Pumps and Drive Units

Pressure Gauge

Modulating Flow Regulating Valve

All valving shall be arranged to permit routine checking of the foam

liquid pump and drive unit as well as periodic circulation of the foam liquid in the piping. The system shall be completely assembled and tested at the factory.

2.2.1 Foam Concentrate Pumps

Foam concentrate pumps shall be suitable for use with an AFFF concentrate. The Contractor shall assure that the mechanical seals are a suitable material for use with the AFFF concentrate. The Contractor shall verify that the pump has adequate capacity to meet the maximum system design requirements as specified on the drawings.

The pumps shall be a positive displacement, rotary type, heavy duty, iron or bronze fitted construction. The pump nameplate flowrate shall be 125% of the flowrate required on the drawings, and the nameplate total dynamic head shall be at least 25% greater than the maximum available water pressure. Pump shall be driven by an electric motor conforming to the specified voltage and environmental requirements. All components shall be mounted on a common steel base with vibration isolators, suitable for mounting on a concrete pad or floor. A separate relief valve shall be furnished with pump and motor assembly. A combination magnetic across the line starter of adequate size and proper enclosure commensurate with specified voltage and environmental requirements shall be provided. The starter shall have a hand-off-automatic selector switch in the cover and a transformer in the control circuit. The starter shall be mounted on the pumping system proportioning package by the system manufacturer. Electric motors shall have a service factor of not less than 1.15.

Pumps shall have adequate means for flushing with clean water after use. They shall be provided with a drain cock or valve.

The AFFF Pump controls shall be of the alternating start type, and shall have an automatic fail over feature to start the backup pump if the lead pump fails to start. The pump shall automatically shut off when the AFFF tank low level is reached. The pumps shall be interlocked so that both pumps cannot operate simultaneously.

2.2.2 Pressure Gauge

The pressure gauge shall be installed to indicate the foam concentrate pressure and shall be mounted directly on the pump discharge piping by the system manufacturer. The pressure gauge shall conform to the following:

Accuracy Within 1% of scale range

Bourdon Tube	Silver soldered phosphor bronze tube with brass socket
Movement	Phosphor bronze
Dial	4-1/2" diameter white with black graduations and numerals
Graduations	Figure Intervals - 50 psi Smallest graduations - 5 psi
Range	0 - 300 psi
Case	Stainless steel case and ring, plastic lens, 1/4 inch NPT bottom connection
Pointer	Balanced adjustable black pointer

2.2.3 In-Line Balanced Pressure Proportioning Unit (I.L.B.P.)

The In-Line Balance Pressure Proportioning Unit (I.L.B.P.) shall be a complete self contained unit designed to proportion foam liquid concentrate with water at the required percentage of concentration over a wide flow range. The unit shall contain all piping, sensing lines, valves and fittings to comprise a complete unit with 150 lb. flanged inlet and outlet water and foam solution connections on the Ratio Controller for field installation. The unit shall have a threaded foam liquid concentrate inlet for connection to the foam liquid supply main. Unit shall be UL listed and/or FM approved. System components shall consist of the following:

Ratio Controller, calibrated to proportion 3% AFFF Foam Liquid.

Duplex Pressure Gauge.

Diaphragm Balancing Valve

Automated AFFF concentrate valve.

****

NOTE: Select ratio controller size based on flow requirements. A /E to verify this data with at least 2 current manufacturer's catalog data:

Ratio Controller	2"	3"	4"	6"	8"
Flow Range GPM	30-180	70-450	150-1200	300-2500	850-4000
AFFF Inlet	1"	1-1/4"	1-1/2"	2"	2-1/2"

****

The unit shall be completely assembled and tested at the factory. Minimum foam solution flow through this unit shall be [____] GPM while the maximum flow shall be determined by the foam liquid pump capacity or the residual water pressure to the unit (not greater than [____] GPM). Design of the unit shall be suitable for vertical or horizontal installation. Manual override capability shall be incorporated into the diaphragm balancing valve to allow for manual pressure balancing using the foam liquid concentrate inlet ball valve. Minimum rated working pressure of the unit shall be 200 psi.

2.2.4 Ratio Controllers

The ratio controllers shall have flanged connections with the ability to proportion foam concentrate over a wide range of foam solution flows. Unit shall be UL listed.

Material	ASTM B-584 Alloy #83600 cast bronze (85-5-5-5) and 300 series stainless steel.
Nominal Solution Flow Range	[____] - [____] GPM
Proportioning Percent	3%
Inlet and Discharge Connections for Water & Solution	[___] 150 lb. flanges
AFFF Inlet Connection	[___] inlet
Minimum Rated Working Pressure	200 psi
Finish	Standard brass. Unpainted.

Water Sensing Port	1/4 inch FNPT

****

NOTE: For 8" ratio controllers select 2" I.L.B.P. diaphragm balancing valve, select 1-1/2" for all smaller ratio controllers.

****

2.2.5 In-Line Balanced Pressure Proportioning Diaphragm Valves

The [1-1/2] [2] inch In-Line Balanced Pressure Proportioning Diaphragm Valves with Manual Override Handwheel shall be provided to automatically balance the foam concentrate pressure to match the water pressure at the ratio controller. This balance shall be achieved by regulating the foam concentrate volume being supplied to the proportioning controller foam liquid inlet connection. The diaphragm valve shall be capable of being manually opened in the event of failure of the diaphragm. Inlet and outlet connections shall be [1-1/2] [2] inch pipe size. The valve shall be UL listed or FM approved and shall conform to the following specifications.

Body and Chamber	Cast Bronze, ASTM B61
Internals	Stainless Steel, ASTM A276
Bushings	Stainless Steel, ASTM #A276
Seals	Neoprene, ASTM D 2000
Diaphragm	Nylon Reinforced Neoprene, ASTM D2000
Piping Connections	[1-1/2"] [2"]
Minimum Rated Working Pressure	200 psi
Flow Range	[10- 120] [_____] GPM, CV = [27] [___]

2.2.6 Duplex Pressure Gauge

The Duplex Pressure Gauge shall be used for sensing the water and foam liquid concentrate pressure. Gauge shall be designed for surface mounting, assembled to a suitable mounting panel by the manufacturer. The duplex gauge shall conform to the following:

Accuracy	Within 1% of scale range

Bourdon Tube	Silver soldered phosphor bronze tube with brass socket
Movement	Phosphor bronze
Dial	4-1/2 inches diameter white with black graduations and numerals
Graduations	Figure intervals - 50 psi Smallest graduations - 5 psi
Range	0 - 300 psi
Case	Stainless steel case and ring, plastic lens, 1/4-inch NPT bottom connection
Pointers	Red pointer actuated by the foam concentrate system. Black pointer actuated by the water system.
Calibration	Gauge shall be calibrated so both pointers coincide within 1 psi at 200 psi set point.

2.3 AFFF DIAPHRAGM TANK

****

NOTE: Diaphram tank option begins here.

****

AFFF Concentrate Proportioning Means shall be a balanced pressure proportioning system utilizing a pressure proportioning diaphragm tank meeting the requirements of NFPA 16A and shall consist of the following:

****

NOTE: Drawings must include a diaphragm tank detail showing all piping and valving arrangements.

****

a. AFFF diaphragm storage tank shall be a steel pressure vessel with a full diaphragm (bladder) within the vessel. The tank shall be rated for 175 psig working pressure and shall be constructed in accordance with the ASME Code Section VIII. ASME labels shall be permanently attached to the tank. The diaphragm shall be nylon reinforced Buna-N

rubber conforming to the inside shape of the tank. AFFF concentrate shall be stored inside the diaphragm and the concentrate shall not be in contact with the steel tank. The tank shall have perforated PVC tubes installed inside to assure full displacement of the stored concentrate. The tank shall be equipped with all the manufacturer's standard fittings and trim including AFFF fill and drain connections, water fill and drain connections, water and AFFF pressure relief valves, water and AFFF pressure gauges, AFFF sight gauge and strainer on the water inlet to the tank. The tank shall be [horizontally mounted on steel saddles] [vertically mounted on a steel ring] suitable for direct mounting on a concrete floor. The Contractor shall fill the tank with AFFF (aqueous film forming foam) 3% concentrate to it's full capacity prior to system testing and shall refill the tank to full capacity upon the successful completion of all required testing. The Contractor shall provide filling and draining instructions mounted under plexiglass where [indicated on the drawings] [directed by the Contracting Officer]. The initial filling of the diaphragm with AFFF concentrate shall be performed and/or directly supervised by a qualified representative of the manufacturer or supplier of the diaphragm tank. A qualified representative shall have at least one year of experience in service or installation of AFFF diaphragm tanks.

b. Ratio Controllers

****

NOTE: Select ratio controller size based on flow requirements. A/E to verify this data with at least 2 current manufacturer's catalog data:

Ratio Controller	2"	3"	4"	6"	8"
Flow Range GPM	30-180	70-450	150-1200	300-2500	850-4000
AFFF Inlet	1"	1-1/4"	1-1/2"	2"	2-1/2"

****

Ratio controllers shall be a flanged ratio controller with the ability to proportion foam concentrate over a wide range of foam solution flows. Unit shall be UL listed, and/or FM approved.

Material: ASTM B-584 Alloy #83600 cast bronze (85-5-5-5) and 300 series stainless steel.

Nominal Solution: [_____] - [_____] GPM

Flow Range

Proportioning Percent 3%

Inlet and Discharge
Connections for
Water & Solution [___] 150 lb. flanges

AFFF Inlet Connection [___] inlet

Minimum Rated
Working Pressure 200 psi

Finish Standard brass. Unpainted.

****

NOTE: (End of diaphragm tank option). The following paragraph is required for either option.

2.4 Automated AFFF Concentrate Valves

Automated AFFF Concentrate Valves shall be stainless steel 1/4 turn ball valves having the following features:

****

NOTE: These line size valves function as 2 position valves in the AFFF concentrate line connecting to the ratio controller for OPTION "B", and just upstream of the I.L.B.P. valve for OPTION "A." The purpose is to limit cross contamination. The water pressure actuator option can be used only when a deluge valve is in the immediate vicinity; such as on a preaction riser with the ratio controller at the base of the riser. Motor operation is to be chosen when ratio controllers and deluge valves are not located together. In either case this MUST BE SHOWN IN A DETAIL ON THE DRAWINGS.

****

(a) The actuator shall be [water pressure] [electric motor] operated and designed for on/off operation of 1/4 turn ball valves; 90 degree rotation.

(b) The valve body, ball [and the cylinder] shall be stainless steel.

[(c) A means of disengaging the cylinder for manually overriding the valve shall be provided.

(d) The cylinder shall be provided with a bronze "y" strainer at the water inlet port.

[(e) The automated valve shall receive its operating water pressure from a line connected to the alarm line of the deluge valve, as indicated. The valve assembly shall be operable with water inlet pressure as low as 40 psig.]

(f) The valve shall have an external mechanical position indicator.

2.5 FIRE ALARM CONTROL PANEL

Fire Alarm Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a neat, compact assembly containing all components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic or metal identification plates for all lamps, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm initiating circuit, located on exterior of cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). Meters and lamps shall be plainly visible when the cabinet of the control unit is closed. Initiating circuits shall have plug-in cards or modules for ease of servicing. Modules or cards shall be removable without disconnecting wiring. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition in the system. Each initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any or all batteries, shall not require the reloading of a program from any source. Upon restoration of power, start-up shall be immediate, automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Enclosures shall be provided with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single enclosure large enough to accommodate all units.

The fire alarm control panel shall provide all primary and emergency power for the operation and the supervision of the fire extinguishing systems as indicated on the drawings. Fire extinguishing systems powered from the fire alarm control panel shall be capable of being powered by the fire alarm system standby emergency batteries. No additional power sources necessary to operate fire extinguishing systems will be permitted. All wiring used to activate fire extinguishing system shall be supervised. Any open or ground shall cause lighting of a trouble lamp and sounding of the system trouble buzzer.

Annunciation shall be part of the fire alarm control panel. A visual annunciator shall be provided for each zone and spare zone as indicated. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic or metal sign with either raised or engraved letters. Zone identification shall consist of word description of the zone. The annunciator shall show all the system condition and alarm condition displays that are indicated on the drawings.

The fire alarm control panel shall have an easily identifiable and accessible (Not locked) reset button, which resets the panel from an alarm condition to its normal status, and shall have a lamp test button for all lamps, LEDs, and the [graphic] annunciator.

2.5.1 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to terminals blocks with each terminal marked for identification.

****

NOTE: A/E shall coordinate with using service for any annunciation requirements beyond that of the FACP itself. LEDs, etc. on the FACP are for the purpose of trouble shooting by maintenance staff and/or the fire dept. Graphic annunciator panels are for providing personnel with emergency information. If provided, show location and configuration on the drawings. Delete or modify 9.3 as needed.

****

[2.5.2 Graphic Annunciator

The graphic annunciator shall be a separate panel wired to fire alarm control panel, and surfaces mounted where indicated on the drawings. The graphic annunciator shall have back lit red plastic rectangles with white

lettering to annunciate the conditions as shown on the drawings. The minimum acceptable lettering height shall be [3/4] [___] inch. The graphic annunciator shall have a NEMA 4 enclosure.]

2.6 STORAGE BATTERIES

Shall be provided and shall be the sealed, [lead-calcium] [lead-acid] [nickel-cadmium] type [with pocket plates,] requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a period of 5 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours than required for the calculated capacities. Battery cabinet shall be a separate compartment from the control panel cabinet.

The battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 8 hours. A separate ammeter shall be provided for recording rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. A pilot light shall indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided. Charger shall be located in control panel or battery cabinet.

2.7 FIRE DETECTING DEVICES

Shall comply with the applicable requirements of NFPA 72E UL 268, UL 268A, and UL 521. The detector shall be mounted as specified or indicated. Detector base shall have terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits.

****

NOTE: The Architectural-Engineer (A/E) shall select the most appropriate heat detector for the application. The rate compensating type shall generally be preferred as the faster and more accurate device. However, where large and rapid temperature increases are anticipated, fixed temperature type detectors shall be specified. Such circumstances are typical of unheated alert type shelters where aircraft engines may be started and/or aerospace ground equipment (AGE)

may operate within the building. The sudden release of large amounts of heat in a cold building can cause rate compensating detectors to false alarm. The A/E shall seek information regarding the users intended operations to make this decision.

****

2.7.1 Heat Detectors

Heat detectors shall be of the automatically self-restoring [rate compensating] [fixed temperature] type, rated for [194] [____] degrees F, and shall be in accordance with UL requirements for automatic operation of the pre-action deluge valves. Additional devices for test purposes shall be provided in accordance with NFPA No. 13. All component parts of the detection system shall be so supervised that failure within the detecting system will result in positive notification of the abnormal conditions. All detectors wiring shall be supervised for shorts, grounds, and open circuits. Detector circuit design shall be suitable for the types and numbers of detectors, as approved by the detector manufacturer and shall limit detector circuit current not to exceed ratings of the detectors and associated relays.

Heat detectors shall be installed throughout the underside of the roof, within 12 inches of the underside of the roof deck.

****

NOTE: A/E shall interpret NFPA 72E, determine correct heat detector spacing, and indicate with note on the drawings. Spacing shall also comply with ETL 1110-3-411, or later criteria. Space detectors no closer than 12 feet apart. Detectors shall be cross zone so that each adjacent detector is on a different zone. Allow a single detector to initiate an alarm.

****

Heat detector spacing shall be as indicated on the drawings. Detectors shall be no closer than 1 foot (horizontally) to any light fixture.

The heat detectors shall be zoned as indicated on the drawings.

****

NOTE: Show location of all UV/IR flame detectors on the drawings. Mounting height shall be between

8 and 10 feet above and shall be indicated on the drawings, and arranged so that underwing areas are viewed by 3 detectors. Indicate that each detector is a separate zone. Require 2 detectors (any 2) to alarm before foam is released.

****

2.7.2 Ultra-Violet/Infrared Flame Detectors

Ultra-violet/infrared flame detectors shall be FM approved or UL listed. Each detector shall be capable of responding to JP-4 fuel fire, 2 X 2 feet in size at a distance of 75 feet, within 5 seconds. The flame detectors shall be installed so that each detector signal shall be brought back to the fire alarm control panel as a single zone. Detectors shall be mounted in such a way so as to view each portion of the protected area with at least three detectors, and also mounted in a way to minimize the extent to which they view areas outside the hanger structure.

The flame detectors shall not be activated by direct or reflected solar radiation, arc welding, lightning, radiant heat, x-rays, normal jet engine functions including direct exhaust blast, normal artificial lighting or radio transmissions. In addition the detectors shall provide the following features:

The detector logic shall require UV and IR signals to be present in the proper ratio, or of a frequency corresponding to a hydrocarbon fire before confirming a fire. Flame intensity shall be the only condition sensed for the detection of a fire.

The detector shall include complete automatic self-testing including through the lens check, IR and UV sensor test, and electronic circuits including all logic and output relay coils without energizing the output signals.

In addition to automatic self test, the detector shall have provisions for manual testing including through the lens check, sensor test, and electronic circuits including all logic. The output circuits shall be energized.

The detector shall be fully functional from -40 degrees F to +145 degrees F. Enclosure shall be aluminum naval bronze or stainless steel, suitable for use in NEMA 4, watertight and dust tight and NFPA, Class 1, Div. 1 Groups C and D: Class II Groups E and G environments.

The detector shall provide outputs for confirmed fire and fault and shall have capability to provide outputs for warning or excessive UV and IR background. All outputs shall be hermetically sealed relay contacts or solid state open collector transistor drive.

The detector shall be equipped with either self-contained or remote processing circuits necessary for confirming the presence of fire and ignoring those signals which would cause false alarms. The detector output circuit shall be capable of direct interface with the flame detector control panel, which in turn controls valves and local alarms. The detector outputs shall also be capable of interfacing with annunciator panels and data acquisition systems.

The flame detectors shall be compatible with the control system.

2.8 SIGNALING DEVICES

Audible signal devices shall be the heavy duty, adjustable sound level type conforming to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits.

****

NOTE: Show location and sequence of operation of all signaling devices on the drawings. Coordinate with using service to determine the most appropriate devices and sequence to use. Delete / add paragraphs as needed.

****

Alarms bells shall be 10-inch surface mounted with matching mounting back box. Bells shall be of the vibrating type, suitable for use in an electrically supervised circuit. Bells shall be the underdome type producing a sound output rating of at least 90 dBA at 10 feet. Bells shall have a separate screw terminal for each conductor, and shall operate with 24 volt DC power.

Alarm horns shall be surface-mounted, vibrating type suitable for use in an electrically supervised circuit and with a sound output rating of at least 110 dBA at 10 feet. Horns shall have a separate screw terminal for each conductor, and shall operate with 24 volt DC power.

Rotating beacons shall be dual sealed beam, motor driven rotating type. Each lamp shall be 25 watts with a red lens. The units shall be suitable for upside down mounting, suspended from roof members, and shall rotate about a vertical axis. Beacons shall have a separate screw terminal for each

conductor and shall operate with 24 volt DC power.

Strobes shall have high intensity optic lens and flash tubes. Strobes shall flash at frequencies between 3 flashes per second, and 1 flash every 3 seconds. Pulse duration shall be 0.2 seconds. Strobes shall be listed or approved for a minimum of 100 candela seconds. Strobes shall have a separate screw terminal for each conductor.

2.9 MANUAL ACTIVATION AND TEST STATIONS

All manual activation and test stations shall be labelled on the front face of the device with permanent engraved labels clearly stating the function of the device. Labels may be integral to the device or attached with metal screws or epoxy resins.

Devices for testing the deluge valves shall be installed alongside the risers, not more than six feet or less than four feet above the finished floor. Devices shall be components of the particular valve trim. Manual stations for the oscillating monitors shall be installed at each monitor.

****

NOTE: The drawings shall show the location of all foam release and abort stations. A sequence of control matrix shall be included on the drawings, completely describing the control sequence of the entire AFFF alarm, detection, supervision, and suppression systems.

****

Foam release stations shall be installed as shown on the drawings and shall be of the pull lever type with a guard cover. Foam release stations shall be of all metal construction.

Abort stations shall be installed as shown on the drawings, and shall be of the "dead man" type, which require personnel to physically hold the abort device until the control panel can be reset. Abort stations shall be of all metal construction.

2.10 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

Ground rods shall be as specified in SECTION: ELECTRICAL WORK, INTERIOR. Conduit shall be rigid steel conduit with a minimum size of 3/4 inch. Wiring for rotating beacon circuits shall be shielded No. 12 AWG minimum. wiring for 120V AC power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring and control

wiring shall be in separate conduits. All wiring shall conform to NFPA 70. All wiring shall be solid copper and installed in conduit. All conductors shall be numbered by wrapping plastic adhesive tape with printed numbers at regular intervals along the insulation. Conductors used for the same functions shall be distinctively coded. Two different codes shall be used for each alarm circuit; one for each loop. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating and alarm indicating circuits are unacceptable.

2.11 SPECIAL TOOLS AND SPARE PARTS

Special tools necessary for the maintenance of the equipment shall be furnished. Two spare sets of fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

2.12 AUTOMATIC OPEN SPRINKLERS

Sprinklers shall be automatic, open type. Preaction overhead sprinklers shall be rated 250-350 degrees F, and installed as required for extra hazard occupancies in accordance with NFPA No. 13. Sprinklers shall be upright type. Orifice sizes shall be in accordance with NFPA No. 13. Sprinklers shall be UL listed or FM approved for 3% AFFF for the designed coverage.

The Contractor shall furnish spare automatic sprinklers in accordance with the requirements of NFPA 13 for stock of extra sprinklers. The sprinklers shall be packed in a suitable container and shall be in representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. The Contractor shall furnish no less than two special sprinkler-head wrenches, or at least one head wrench for each container or sprinkler box, whichever is greater.

2.13 DELUGE VALVES

Deluge valves for preaction risers and oscillating monitors shall be approved type provided with standard trim and all necessary auxiliary UL and/or FM mandated equipment as required by the valve used for a complete and operable 24 volt DC electrically actuated deluge system, suitable for manual and automatic operation. Deluge valves shall be externally resettable by operation of the valve trim, without removing the valve's face plate.

****

NOTE: A/E to select oscillating monitor flow

characteristics and layout to provide .10 GPM/FT2 min. to the aircraft shadow area. Verify with manufacturer's data that monitors will perform at anticipated system flows and pressures. To preclude damage to the aircraft skin, the maximum discharge from any one monitor shall not exceed 350 gpm.

****

2.14 OSCILLATING MONITORS

Oscillating monitors shall discharge [200] [____] GPM with a straight stream range of approximately [60] [___] ft. minimum, with an oscillating arc adjustable from 0-120 degrees. Monitor shall have a lever to permit manual operation. The oscillating power shall be obtained from the foam/water solution supplied for fire suppression. Monitor shall have manually adjustable elevation setting. The elevation setting and arc setting shall not be readily accessible to or subject to disturbance by untrained personnel.

****

NOTE: A/E shall seek guidance from the Corps of Engineers project manager as to what degree, if any, of backflow protection is required and edit or delete this paragraph accordingly. In designing the system the A/E shall take into consideration the pressure drop of these devices - especially of the reduced pressure type.

****

2.15 BACKFLOW PREVENTERS

Backflow preventers shall be of the [double check assembly] [reduced pressure assembly] type, factory equipped with upstream and downstream gate valves. Units shall be UL listed or FM approved, and shall be tested, approved and listed by the Foundation for Cross-Connection Control and Hydraulic Research. [Reduced pressure assemblies with intermediate atmospheric vent shall be in accordance with ASSE 1012.] The gate valves shall have tamper switches and shall be connected to the Fire Alarm Control Panel.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with NFPA 13 and the manufacturer's diagrams and recommendations unless specified otherwise herein. Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. The system shall be installed by an experienced firm regularly engaged in the installation of fire-protection sprinkler systems in accordance with NFPA standards. The Contracting Officer may reject any proposed installer who cannot show evidence of such qualifications. Contracting Officer's approval will not relieve the Contractor from his responsibilities to perform all work in accordance with the contract.

3.2 PERSONNEL PROTECTION

Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts, shall be so located as to be fully enclosed or guarded to prevent a person coming in contact therewith.

3.3 SYSTEM POWER SUPPLY

A single dedicated branch-circuit connection for supply power to each building system shall be provided. Emergency power supply shall be automatically transferred upon failure of the normal power supply.

3.4 WIRING

Wiring for systems shall be installed in 3/4-inch minimum diameter conduit; however, the wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to terminals with each terminal marked in accordance with the wiring diagram for identification. Connections shall be made with either crimp-on-terminal spade lugs or with approved pressure type terminal blocks. All wiring within any control equipment or panel shall be connected with approved pressure type terminal blocks only, and shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.5 FIRE ALARM CONTROL PANEL

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 18 inches above the finished floor nor more than 78 inches above the finished floor. All manually operable controls shall be at least 2 1/2 feet and less than 5 1/2 feet

above the finished floor. Panel shall be installed to comply with the requirements of UL 864. Batteries shall not be installed above the panel.

3.6 DETECTORS

Detectors shall be installed in accordance with NFPA 72E, or as modified hereinbefore. Detectors shall be at least 12 inches horizontally from any part of any lighting fixture. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

3.7 SIGNALING DEVICES

Signaling devices shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.

3.8 ANNUNCIATOR EQUIPMENT

Annunciator equipment shall be mounted and provided where indicated.

3.9 GROUNDING

Grounding shall be provided to building ground or ground rods shall be driven. Maximum impedance to ground shall be 25 ohms. Ground rods shall not protrude more than 6 inches above grade.

3.10 UNDERGROUND PIPE AND FITTINGS INSTALLATION

The sprinkler-system supply line shall be laid below the local frostline. Depths of cover over water pipes shall be in accordance with NFPA 24. Connection to the water-supply main shall be performed as directed by the contracting Officer in order to minimize the inconvenience resulting from water-service interruption. Where connection of the sprinkler supply line to the water supply main cannot be made immediately, the sprinkler supply line shall be extended five feet outside of building, and capped. Change in direction of pipe shall be made with suitable standard fittings, except that defections from a straight line will be permitted provided such deflections in either the horizontal or the vertical plane do not exceed 6/D inches per linear foot for pipe less than 14 inches in nominal diameter, or 4.5/D inches per linear foot for pipe 14 inches and larger in diameter, where D represents the nominal diameter of the pipe expressed in inches, between the extended centerlines of any two connecting pipes. The supply line shall

terminate inside the building or valve house with a special flanged piece, with the bottom of the flange set not less than 4 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. Fittings shall have joints and pressure-class ratings compatible with the pipe used, all conforming to NFPA 24.

3.10.1 Joints

Joints shall be of the mechanical, single-gasket, push-on, or bell-and spigot type. Each joint shall be made in a manner approved by the Contracting Officer. All joints shall be left exposed until final inspection and tests have been made. Bell-and-spigot joints shall be made by carefully centering the spigot in the bell. Calking lead, approved joint compounds, or approved rubber gaskets without calking where bell end of pipe locks gasket against displacement, may be used at the option of the Contractor. Lead joints shall be poured in one continuous flow from the ladle. Each joint requiring calking shall be calked at least three times around, using the proper-size calking irons. Mechanical joints shall be of the stuffing-box type and mechanical and push-on joints shall conform to ANSI A21.11.

3.10.2 Bracing and Clamping

Bends, plugs and tees shall be braced or clamped in accordance with the requirements of NFPA No. 24. The connection between the underground piping and the base of the riser shall be anchored by means of tie rods and pipe clamps per NFPA 13.

3.10.3 Control Valves

Valves shall conform to UL requirements, and shall be gate valves with indicator posts, installed in accordance with NFPA No. 24, where indicated.

3.10.4 Indicators Post

Posts shall conform to UL requirements or as listed in FM Approval Guide and shall be compatible with existing indicator valves.

3.10.5 Excavation, Trenching, and Backfilling

Earthwork shall be performed in accordance with applicable requirements of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.11 ABOVEGROUND PIPE AND FITTINGS

Pipe shall not be subject to a working pressure in excess of 25 percent of the hydrostatic pressure test required by the standard applicable to the pipe. Pipe shall have a rated working pressure of at least 175 psig.

3.11.1 Joints

Joints shall conform to NFPA 13. Shop welded joints will be permitted. Flanged joints [or mechanical rolled or grooved couplings] shall be provided where indicated or required by the NFPA 13. [Plain end couplings shall not be acceptable. All mechanical couplings shall be of the rigid type.]

Threaded joints shall be cut with an approved thread-cutting oil and shall conform to Fed. Std. H28. Not more than three threads shall show after the joint if made up. All joints shall be made tight with teflon tape.

Flanged joints shall be faced true, provided with 1/16-inch non-asbestos gaskets in accordance with Fed. Spec. HH-G-156D, and made square and tight.

3.11.2 Couplings

Special couplings, grooved couplings and flexible connections approved for use in sprinkler systems may be used in place of unions and flanged connections where applicable. All mechanical couplings shall be of the rigid type.

3.11.3 Fittings

Fittings for aboveground piping shall be of a type specifically approved for use in sprinkler systems. Bushings shall be used only where standard fittings of the required size are not available. The use of bushings is further restricted by requirements of NFPA 13.

3.11.4 Reducers

Reductions in pipe sizes shall be made with one-piece reducing fittings. Bushings will not be acceptable, except that when standard fittings of the proper size are not available, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2-inch.

3.11.5 Pipe Supports and Hangers

The recommended methods and requirements for supporting and hanging pipe as set forth in NFPA 13 shall be mandatory.

3.11.6 Pipe Sleeves

Pipes passing through concrete or masonry walls or concrete floors shall be provided with pipe sleeves fitted into place at the time of construction. All rectangular and square openings, in ceilings may be steel pipe, cast iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Pipe sleeves through floors at the connection of risers to underground piping shall provide a minimum of 1/4-inch clearance on the outside of the tie rods hereinbefore specified. Sleeves through floors shall extend 2 inches above the floor surface.

In addition to the pipe sleeves referred to above, pipes passing through floor waterproofing membrane shall be provided with a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than eight inches from the pipe and shall set over the floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10-inches above the floor. The annular space between the flashing and the pipe shall be sealed as indicated. At the Contractor's option, pipes passing through floor waterproofing membrane may be installed through a cast iron sleeve with calking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Waterproofing membrane at floors shall be clamped into place and sealant shall be placed in the calking recess.

Pipes passing through fire walls, fire partitions, and floors: Where pipes pass through fire walls, fire partitions, or floors, a fire seal of mineral wool, or similar noncombustible material shall be placed between the pipe and sleeve. Penetrations shall be as detailed and located where indicated.

3.11.7 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping passes through floors, walls, or ceilings except in mechanical or AFFF equipment rooms. Escutcheons shall be fastened securely to pipe and shall be chromium-plated steel or chromium-plated brass, either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.11.8 Drains

The preaction sprinkler system shall be provided with complete drainage facilities as indicated and in accordance with NFPA 13, with the additional requirement that all sprinkler piping attached to the same riser shall drain to a common drain valve. The drain valve may be located on the riser, and shall be no higher than 7 feet above the floor.

3.11.9 Protection of Piping in Seismic Zones

Protection of piping against earthquake damage is required. Methods of protection Shall be in accordance with applicable requirements of NFPA 13 and Appendix A.

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NOTE: Retain heat tracing cable paragraph only if such piping is to be located in an unheated area subject to freezing, such as a large open hangar bay, or alert shelter. Heat tracing cable should be used only as a last resort if there are no practical alternatives. AFFF equipment rooms should normally be heated to at least 45 F. AFFF concentrate viscosity changes at approximately 40 F.

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[3.11.10 Heat Tracing Cable

Above ground piping of 1 inch diameter or smaller which contain water, AFFF concentrate, or foam water solution shall be protected from freezing with heat tracing cable with the following exceptions. Heat tracing cable is not required in any heated building areas, or on the normally dry overhead preaction sprinkler piping. Heat tracing cable is required in the unheated aircraft hangar on trim piping associated with the deluge valves, [and _____]. The heat tracing cable shall be a parallel circuit, self limiting electric heater consisting of copper bus wires bonded to a self regulating semiconductive core insulated with a modified polyolefin jacket. Heat output shall not be less than 3.0 watts per lineal foot of cable at 40 degrees F. Cable shall be UL listed or FM approved and shall operate with 120V, single phase power. Cable shall be installed on a straight run over the piping, secured with plastic tie wraps or glass tape, and shall be covered with 1/2 inch thick insulation. Insulation shall not interfere with the operation of drain or test valves. Manufacturers recommended power connection kits and end seals shall be used. One ambient sensing thermostat set at 40 degrees F. shall be provided for each 120V branch circuit connection used.]

3.12 DISINFECTION

Before acceptance of the foam suppression system, each section of the completed system shall be disinfected as specified herein. Piping which is to be filled with compressed air is excluded from this requirement. The unit to be disinfected shall be flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MATERIALS. The chlorinating material shall provide a dosage of not less than 50 parts per million (p/m) and shall be introduced into the system lines in an approved manner. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 10 p/m of chlorine throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 p/m. From several points in the section, the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The disinfection shall be repeated until tests indicate the absence of pollution for at least two full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.13 FIELD PAINTING

See Section 09900: PAINTING, GENERAL.

3.14 INSTRUCTIONS FOR TESTS, INSPECTIONS, OPERATION, AND PREVENTIVE MAINTENANCE

Upon completion and prior to acceptance of the installation, the Contractor shall subject the system, including the underground supply connection, the tests required by NFPA 11, NFPA No. 13, and NFPA 16A and shall furnish the Contracting Officer with a certificate as required thereof.

The Contractor shall comply with the following provisions:

a. No waivers of any test will be permitted. The Contractor is required to plan and schedule testing to meet all other building and safety requirements.

b. The Contractor shall notify the Contracting Officer at least two weeks prior to all tests. Notice shall include type of test and date and time of tests. All testing shall be conducted on a

continuous, consecutive day basis. The Contracting Officer or designated representative shall be allowed to observe all tests. This does not relieve the Contractor of his responsibilities.

c. The Contractor shall furnish at his expense all materials, equipment, and personnel to conduct the tests including items to gain access, measure, or observe specific operations in the test. The Contractor is responsible for cleaning and restoring all systems and areas to normal conditions after completion. Disposal of waste is also the Contractor's responsibility. The AFFF waste generated during testing shall be contained in a definable area. The Contractor shall collect this waste and dispose of it at an approved disposal site.

d. An approved portable testing unit, suitable for testing the type of heat detectors installed, shall be provided. The testing unit shall be capable of producing the heat necessary to operate heat-detectors. Units employing unprotected open flames or incandescent electric elements will not be acceptable. In addition to the hydrostatic tests specified, all automatic and/or manual releasing devices shall be tested as a Contractor quality control requirement using the testing equipment specified.

e. Required test shall be scheduled to coincide with work in progress to assure all tests have been completed by the time the building is to be released for occupancy.

f. AFFF concentrate tests shall be performed by a qualified representative of the AFFF supplier or manufacturer. A qualified representative shall have at least one year of experience performing AFFF concentration tests and other related testing.

g. After successful completion of the tests, the Contractor shall deliver the testing unit to the Contracting Officer and shall refill the AFFF concentrate tank to its full capacity with AFFF concentrate. The AFFF concentrate piping between the tank and the automated AFFF concentrate valve shall also be filled with AFFF concentrate after the testing.

h. AFFF concentrate tests shall be performed by a qualified representative of the AFFF supplier or manufacturer. A qualified representative shall have at least one year of experience performing AFFF concentration tests and other related testing.

3.14.1 Flushing and Hydrostatic Pressure Test

All underground mains and each lead-in connection shall be flushed to provide ten (10) foot per second velocity or maximum flow, whichever is greater. Table 1 gives minimum flow rates to achieve the required velocity:

TABLE 1

PIPE SIZE	FLOW RATE
4 inch	600 GPM
5 inch	600 GPM
6 inch	880 GPM
8 inch	1560 GPM
10 inch	2440 GPM
12 inch	3520 GPM

The Contractor shall provide the necessary equipment and verify the flow rates.

All mains and cross mains (as a minimum) shall be flushed at no less than ten (10) feet per second.

All systems [including underground piping] shall be hydrostatic tested at not less than 200 psi for two hours or at 50 psi in excess of maximum pressure when the system is designed for pressures in excess of 150 psi. The test pressure shall be read from a gauge at the low elevation of the system or portion of the system being tested. The following leakage is permissible:

a. Inside piping - None.

b. All foam piping - None.

c. Underground piping permissible leakage is two (2) quarts per hour per 100 gaskets or joints. This shall be measured at the specified test pressure by pumping from a calibrated container. The amount of allowable leakage specified above may be increased by one fluid ounce per inch valve diameter per hour for each metal seated valve isolating the test section. If dry barrel hydrants are tested with the main valve open, so the hydrants are under pressure, an additional five ounces per minute leakage is permitted for each hydrant.

3.15 AFFF CONCENTRATE TEST

This test shall be utilized to test the concentration of foam mixed with water. The following minimum items shall be made available:

a. Three (3) 100 ML graduated tubes.

b. Two (2) measuring pipette (10ML capacity).

c. One (1) hand refractometer (American Optical Co., Model 10430 or equal).

d. Sufficient AFFF collectors as described in NFPA 412.

e. All other containers and apparatus necessary to conduct the test of oscillating monitors.

Test Procedures:

a. Draw samples of foam and water from the system in separate clean containers. Foam concentrate shall be drawn from the concentrate test connection.

b. Mix three (3) sample solutions of AFFF and water with the following concentrations:

1. 2.0%
2. 3.0%
3. 4.0%

c. Determine refractometer reading for each sample solution listed above. Record these refractometer readings.

d. Compare recorded sample solution refractometer reading with readings obtained from system test sample solutions of AFFF and water. The system tests should produce the same refractometer reading as that of the sample 3% solution.

e. The system test concentration shall be within the following limit: 3% to 4%.

3.16 FIRE SUPPRESSION SYSTEMS TESTS

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NOTE: Use ratio controller flow rates from paragraph above.

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Ratio-Controller shall be tested in an approved manner in accordance with NFPA 16A in the presence of the Contracting Officer. Test shall demonstrate that the controller induces the correct quantity of concentrate into the fire line to produce a 3% final solution concentration within the above noted tolerance when any water quantity between [____] GPM and [_____] GPM is being discharged through them. The ratio-controller shall be tested at minimum, maximum, and 50% between minimum and maximum flow rates. A chemical analysis shall be furnished to the Contracting Officer to verify the concentrations.

3.16.1 Trip Tests

Trip test each system by activating a heat-responsive actuating device. The system control valves should be wide open and all water supplies, including fire pumps, should be in service. This will allow full expected flow to be impressed upon the system in order to test the integrity of piping, fittings, hangers, valve clapper, etc. During this test check for proper operation of supervisory equipment, water flow alarms, and interlocking controls for starting fire pumps, sounding alarms, etc. The time required for the portable testing unit to trip the preaction valves shall be measured and recorded. The time delay between the preaction valve trip and delivery of water shall be measured and recorded. The maximum allowable delay shall be either one minute for every 400 feet of common feed main, or 3 minutes, whichever is less.

After a successful full-flow trip test, additional trip tests to ensure proper operation shall be made for each heat-responsive device and manual trip station, both local and remote. These tests shall be made with the system control valves closed after successful completion of trip tests. The system piping shall be drained and left in service.

3.16.2 Hydrostatic Pressure Test

Hydrostatic pressure test for piping shall be performed as previously specified.

3.16.3 Testing of Oscillating Monitors

The following test shall be conducted for the oscillating monitors:

a. Measure and record discharge flow rate and pressure for all monitors while operating simultaneously

b. Time and record complete operations test.

c. Foam concentration test.

d. Hydrostatically test all components in accordance with this specification

Water shall only be discharged from each monitor for two (2) minutes. The discharge pressure shall be recorded during this time. Monitor arc and throw shall be adjusted as shown on the drawings.

3.17 OPERATIONAL TESTS

Operational tests shall be performed to test all operational features, and for foam pattern and foam quality.

As specified in paragraph AFFF Concentrate Test, place foam collectors within the coverage area of each monitor. The test will be activated by a flame detector in the manner described below. The test time shall begin from activation of the second detector and shut down exactly 55 seconds after the second detector operates. There can be no more than a 10 second delay prior to discharge of foam. The time delay from second flame detector actuation to completion of a single sweep of each monitor shall be measured and recorded. After the test the shadow area of the aircraft will be inspected to ensure all areas have been covered. The samples of foam will be labeled and concentrates recorded as specified in paragraph AFFF Concentrate Test. All aircraft shadow areas shall be covered for the system to be acceptable. At the conclusion of the test, the supply lines leading to the monitors shall be charged with foam water solution up to the deluge valves.

During the test, the drainage and diversion systems shall be checked for proper operation. Foam waste containment shall be provided by the Contractor.

Each monitor shall also be tested in the manual mode, discharging water.

Each hose station shall be flow tested with water to verify operation.

3.18 FIRE ALARM AND DETECTION SYSTEM TEST

Each manual fire alarm and foam release station shall be tested to verify proper activation of control circuits. These tests shall be conducted so as to verify all activation mechanisms without water flow.

Each abort station shall be tested to assure the capability to shut down the systems when system is activated and to resume activation of the system when

the device is released.

All supervisory circuits including each tamper, water flow, monitoring, (i.e., temperature alarm, low water, etc.) and control device shall be tested for proper activation and setting.

Detector system tests shall be conducted prior to acceptance of fire suppression systems. Suppression systems shall be shut off to prevent water flows.

Combination UV/IR flame detector test shall be performed for block out of detector signal when UV conditions only exist.

The Contractor shall conduct a UV-only test by performing an arc welding operation within the field of view of each UV/IR detector. All necessary equipment and materials to conduct this test shall be furnished by the Contractor. The welding operation shall consist of the shielded metal arc process using 3/16-inch welding electrode on minimum 1/4-inch thick steel with a welding current of 50 amps. This test shall be performed twice per detector for 2 minutes each.

The Contractor shall perform a UV/IR Flame Detector System Fire Pan Test on the UV/IR Detection system. The Contractor shall provide a test pan that shall be 2 ft. by 2 ft. by 4 inches deep that the detectors must respond to within 5 seconds at a distance of 100 ft. The fire pan test shall consist of 2 gallons of JP-4 fuel (provided by the Government) the pan shall be filled with water to within 3/4 inch of the pan rim. During the fire pan test, timing shall start 2 seconds after initial JP-4 ignition or when the flame front covers the entire pan, whichever is later. During testing, all hanger doors and mechanical ventilation systems shall be disconnected and monitor system and over head pre-action systems shall be deactivated to prevent discharge. The Contractor shall coordinate the test with the base fire department for assistance in extinguishing the test fires. All tests shall be witnessed by representative of the Contracting Officer. Corrections shall be made to flame detectors or controls not responding and test repeated as necessary. During each test, only those flame detectors that can "see" the fire need respond, but at the end of the tests, all flame detectors must have responded to the test fire closest to them (in their field of view) within the response time as hereinbefore specified.

Heat detectors shall be tested as required by NFPA Standard 72E.

All signalling devices shall be operationally tested.

All conductors, including shield drain conductors shall be tested for

continuity, shorts to ground, and shorts between pairs.

Receipt of all alarm and trouble signals, initiated during the course of testing, shall be verified at each annunciation device.

Correct labeling of all fire alarm control panel annunciaton [and the graphic annunciator] shall be verified.

The system control equipment and annunciators shall be load tested on standby battery power for not less than 12 hours.

The Contractor shall provide documents showing certification of materials and tests in accordance with NFPA 13. The Contractor is responsible for clean up and returning the facility and systems to normal condition prior to acceptance of the sprinkler system installation.

3.19 TRAINING

The Contractor shall provide at least two training sessions lasting four (4) hours each. The training sessions shall provide instruction on the specifications and maintenance of the installed systems. Training shall be on all alternate days to facilitate training shift personnel. All training sessions shall be videotaped by the Contractor, and the videotapes shall be delivered to the Contracting Officer in VHS format. Training shall not be scheduled until all testing has been successfully completed and Operation and Maintenance Manual has been approved. The Contractor shall provide at least 7 days notice prior to the start of training.

Initial Operator Training

a. Classroom Training Session - 2 Hours

1. Description of system (basic verbal orientation)

2. Manual controls (abort and foam release stations, valve and monitor operation)

3. Automatic controls (UV/IR detectors, heat detectors, foam release stations.)

4. Audio/visual signals (horns, bells, rotating beacons, alarm/trouble LEDs, buzzers, [and graphic annunciator])

5. User operation of control panel (alarm acknowledgment, alarm silence, reset, alarm resound)

6. Written test (to be corrected in class)

7. Review of the Operation and Maintenance Manual

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NOTE: If the diaphragm tank option is chosen, delete bracketed text below.)

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[8. Fire [and AFFF] pump manual control functions.]

b. 15 Minute Break

c. Hands-On Training Session (in hangar) - 2 hours

1. Review of classroom session with actual operation of equipment.

2. Demonstrate zoning of UV/IR detectors.

3. Demonstration of a fire scenario with Air Force personnel operating the system.

4. Operate monitors while dispensing water.

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NOTE: For the atmospheric tank with pumps option, delete bracketed text below.

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[5. Demonstrate proper filling method of the AFFF diaphragm tank.]

6. Various alarm and trouble conditions induced into the system. Slides, visual handouts and/or overhead graphics shall be used to enhance the classroom training. All training sessions shall be videotaped for educating new personnel and refresher courses, and the video tapes delivered to the Contracting Officer.

The Contractor shall conduct two (2) four hour training sessions [3] [_____] months after turnover of the completed facility to the government. The training agenda shall be similar to that specified above for the initial operator training. [$5,000] [_____] shall be retained by the government pending successful completion of the follow-on operator training. The Contractor shall provide at least [14] [_____] days written notice to the Contracting Officer prior to scheduling the follow-on training. Follow-on training sessions shall be video taped as specified for the initial operator

training, and the video tapes shall be delivered to the Contracting Officer.

The Contractor shall furnish the Contracting Officer with a 10% back-up stock of each type detector. A minimum of one (1) detector shall be provided for smaller systems.